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# **Ontario Department of Agriculture**

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**ONTARIO AGRICULTURAL COLLEGE**

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## **SUGAR BEETS**

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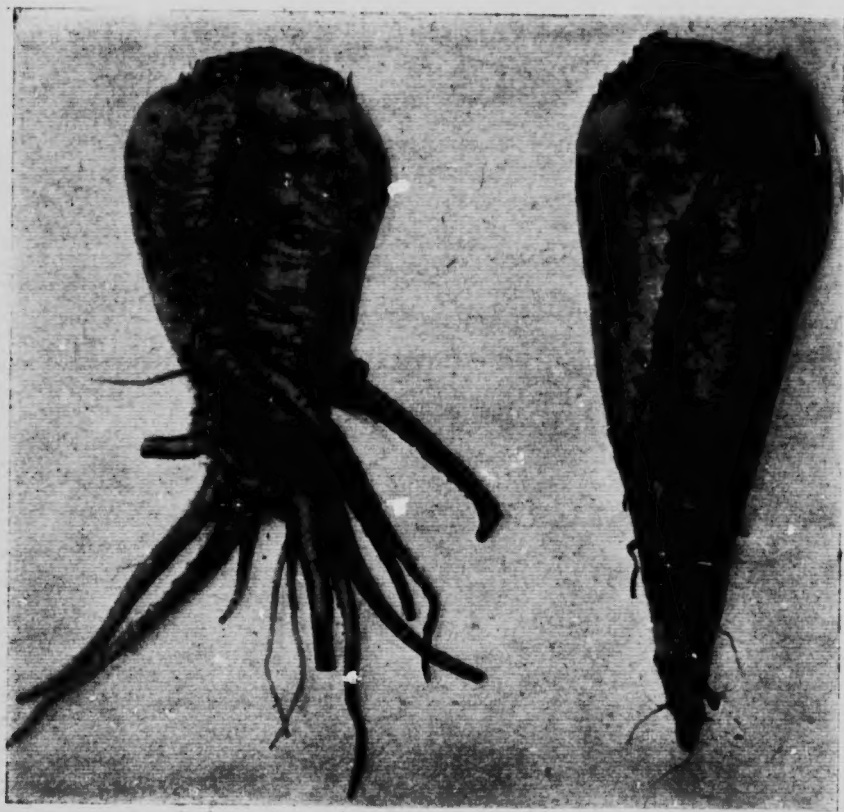
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**TORONTO, ONTARIO, MARCH, 1918.**



**KLEINWANZLEBENER SUGAR BEETS.**

**Left: Root grown under adverse soil conditions.**  
**Right: Root grown in mellow soil.**

# Ontario Department of Agriculture

## ONTARIO AGRICULTURAL COLLEGE

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# SUGAR BEETS

By C. A. Zavitz and A. W. Mason

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### SUGAR PRODUCTION.

The sugar production of the world, under normal conditions, amounts to about twenty million tons annually. Approximately one-half of the total supply is made from beets and one-half from cane. About three-quarters of the cane sugar is produced in Cuba, India, and Java and one-quarter of the beet sugar in Germany.

In the average for the nine years from 1905 to 1913 inclusive, five countries which are now at war, namely, Russia, France, Belgium, Germany and Austria-Hungary, produced 40 per cent. of the world's total supply of sugar and 87 per cent. of the sugar made from beets. Of the amount of sugar produced in the five countries here referred to, Germany and Austria-Hungary produced 60 and Russia, France and Belgium produced 40 per cent. Practically all of the sugar of Russia, coming about 9 per cent. of the sugar of the world, was produced in the south-western portion known as Little Russia or Ukraine.

Before the outbreak of the war, England imported about 1,400,000 tons of sugar from Germany and other neighboring countries. France produced 750,000 and Italy 210,000 tons before the war, and in 1917 the production had fallen to 207,000 tons for France and 75,000 tons for Italy.

It has been recently stated that Great Britain, France and Italy require for use during 1918 approximately two million tons of sugar to be secured from countries outside of Europe. To obtain this supply from India or Java would take three times as long for transportation as to secure it from Cuba. As Cuba furnishes 48 per cent. of the sugar used in the United States, the supply for export to Europe is, therefore, greatly reduced. The domestic production of sugar is 23 per cent. in the United States and only about 5 per cent. in Canada, the rest of the supplies being imported.

The estimated consumption of sugar per capita per annum in the United States for the five years from 1912 to 1916 inclusive, was 84.7 pounds, and for the year from August 31st, 1916, to August 31st, 1917, 88.3 pounds. The consumption of sugar in Canada per unit of population is estimated to be fully as great as that of the United States. In August, 1917, the British Government reduced the household sugar ration to a basis of 24 pounds per annum per person, and in the following month the French Government reduced the annual ration per capita to 13.2 pounds.

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### THE SUGAR BEET INDUSTRY IN ONTARIO.

Not only have sugar beet experiments been conducted at the Ontario Agricultural College, but co-operative experiments have been conducted by the Depart-

ment of Field Husbandry through the medium of the Experimental Union and by the Department of Chemistry in testing and analyzing sugar beets in various parts of the Province. The Chemical Department analyzed samples of sugar beets which were forwarded to the College from different parts of the Province as follows: 26 in 1889, 117 in 1890, 32 in 1891, 40 in 1897, and 89 in 1899. These samples varied greatly in amount of sugar, many of them giving less than twelve per cent. The low percentage of sugar was due to the fact that some of the varieties forwarded by the growers were unsuitable for sugar production, and in many instances the beets were grown as ordinary root crops with but little special reference to high sugar production. Of all the samples analyzed 158 out of 304 or practically 52 per cent. were below the standard for factory purposes. The investigational work, however, showed that under proper conditions, Ontario could grow sugar beets with good satisfaction for sugar production. By more thorough and systematic experiments conducted by the Chemical Department it was clearly shown that in yield, in quality, and in cost of cultivation of sugar beets, Ontario farmers in certain extensive districts of the Province could realize comparatively large profits by growing sugar beets and selling the same at the prices paid by American beet sugar factories.

In 1901, four sugar beet factories with an aggregate capacity for slicing two thousand two hundred tons of beets per day were built at Berlin, Waterloo County; at Wiarton, Bruce County; and at Wallaceburg and Dresden, Kent County. In 1904, the Dresden Sugar Company removed their factory to the State of Wisconsin, and the Wiarton Sugar Manufacturing Company suspended operations. In 1915 and 1916, an exceptionally fine sugar beet factory was erected at Chatham, and in 1917 beet sugar was manufactured by the Dominion Sugar Company at their three factories in Kitchener, Wallaceburg, and Chatham. These three factories collectively can manufacture sugar from approximately thirty-three thousand acres of sugar beets. They are offering for 1918 an option of \$9 per ton for sugar beets with an increase of \$1 per ton for each advance of one cent over eight cents in the wholesale price of sugar or of \$8.75 per ton for beets analyzing twelve per cent. sugar with an increase of 33 $\frac{1}{3}$  cents per ton for each advance of one per cent. of sugar. In the past few years the sugar beets grown in Ontario have given an average of about ten tons per acre and of sixteen and one-half per cent. of sugar. In consideration of the great scarcity of sugar throughout the world it seems reasonable to expect that a sufficient quantity of sugar beets of high quality will be grown in Ontario to supply the three factories to the limit of their capacity.

In France, Germany and Austria-Hungary, women and girls did much of the thinning and the weeding of the sugar beets previous to the war. Owing to the present scarcity of labor in Ontario, women and girls from towns and cities could help materially in thinning, weeding and hoeing the sugar beets during the war period.

#### VARIETIES OF SUGAR BEETS AND OF SUGAR MANGELS.

The percentage of sugar amounts to approximately five per cent. in mangels, ten per cent. in sugar mangels, and fifteen per cent. in sugar beets. There are, of course, quite decided variations in the percentage of sugar owing to varieties used and methods of cultivation practised. Mangels grow largely above the ground, sugar beets almost completely under the surface of the soil, and sugar



occupy an intermediate position in this respect. Mangels and sugar mangels are grown for feed production and sugar beets for the manufacture of beet sugar.

Numerous experiments have been conducted at the Ontario Agricultural College in growing mangels and sugar mangels as feed for farm stock, and in growing sugar beets to determine the quantity and the quality of the roots produced in Ontario for sugar production.

For six years in succession fourteen varieties of sugar beets and sugar mangels were carefully tested under uniform conditions in the Field Husbandry Department at the College. The tests were made in the experimental field which is composed principally of an average clay loam. The land received one application of farm-yard manure in each rotation of four years, no commercial fertilizers being used. The roots followed grain crops, the land being ploughed in the autumn. The rows were 21 inches apart and the roots 7 inches apart in the rows. At the time of harvest careful determinations were made of the weights of both the roots and the tops and of the number of roots of each variety. A number of average roots were collected each year and taken to the Chemical Department, where they were analyzed. The following table gives the average results of the six years' experiments in showing the yields per acre and the quality of the roots for sugar production:

Varieties.	Average 5 years.		Average 6 years.				
	Length of Roots.		Weight per Root (lbs.)	Yield per Acre.		Analysis of Juice.	
	Above Ground (ins.)	Below Ground (ins.)		Tops (tons).	Roots (tons).	Purity.	Sugar.
1 Improved Imperial....	.57	5.66	.99	5.98	18.42	88.5	17.0
2 Kleinwanzlebener ....	.58	6.02	1.04	8.47	20.68	87.8	16.6
3 Petzscheke's Elite....	.62	5.97	1.06	6.62	19.07	87.1	16.1
4 Champion .....	1.31	6.77	1.05	7.70	20.69	85.0	15.6
5 White Silesian.....	1.14	6.14	1.19	5.77	22.57	83.0	13.7
6 Lane's Improved ....	1.61	5.73	1.11	5.22	21.54	82.5	12.8
7 French Yellow.....	1.45	6.36	.95	4.59	17.81	82.7	12.7
8 Green Top White....	1.08	5.77	1.15	5.72	22.61	81.0	12.6
9 Red Skinned.....	1.83	6.22	1.18	4.45	22.94	80.8	11.7
10 Red Top.....	2.72	5.47	1.24	3.96	24.54	81.4	10.9
11 New Danish Improved	2.65	5.59	1.27	6.66	25.20	80.8	10.8
12 Giant Rose Feeding...	3.22	5.15	1.29	2.48	25.93	81.7	10.3
13 Royal Giant.....	3.50	5.27	1.36	2.95	26.97	79.7	9.9
14 Giant White Feeding..	3.78	4.68	1.49	3.48	29.91	72.2	8.4

Of the fourteen varieties of roots included in the table here presented, the Kleinwanzlebener gave the highest average total yield of sugar per acre, when both the yield and the quality of roots were taken into consideration. This variety originated in Germany by selecting for many years only those roots which had a very high sugar content. The Kleinwanzlebener variety of sugar beets has been used more extensively for sugar production in America than any other variety. It will be seen that those varieties of beets which gave the highest percentages of sugar produced medium sized roots, which grew almost entirely underground. In comparing the different varieties it will be noticed that as the percentage of sugar decreased there was usually an increase in the yield of roots and a decrease in the

yield of tops. There are, however, some marked exceptions to this rule, as the New Danish Improved gave a very large yield of tops and a comparatively low percentage of sugar, and the French Yellow variety which furnished an average amount of sugar was the lowest yielder of roots on the list. This table is worthy of careful study.

At least nine dollars per ton is being offered for sugar beets in Ontario for 1918. The average yield per acre at Guelph of the Kleinwanzlebener variety was 20.68 tons per annum. This yield multiplied by the price per ton, less the tare, would furnish a large return per acre. This, of course, would be higher than average returns for the Province, but with present prices there are special opportunities for sugar production in Ontario.

Four varieties of sugar beets and sugar mangels have been grown under similar conditions in the experimental grounds in each of twenty-one years. The following gives the average results for the twenty-one year period in pounds per root and in tons per acre of both tops and roots: Kleinwanzlebener, 1.1, 6.5, 16.7; Improved Imperial, 1.2, 5.1, 16.5; White Silesian, 1.3, 5.4, 19.2; and New Danish Improved, 1.4, 4.8, 15.5. The percentage of sugar of these varieties was not determined except in the six years already reported in the foregoing table.

In each of the past four years, Ontario grown seed, from a special variety of sugar beet particularly rich in sugar content, has been obtained from the Dominion Sugar Company. This variety and the Kleinwanzlebener have been grown in the experimental plots under similar conditions for the four-year period. The following gives the results of this experiment in yield per acre of both tops and roots:

Variety.	Tons of Tops per Acre.				Tons of Roots per Acre.			
	1914	1915	1916	1917	1914	1915	1916	1917
Kleinwanzlebener .....	6.1	13.6	1.8	5.5	15.4	18.8	3.9	14.6
Dominion Sugar Co. ....	6.3	15.9	2.1	6.3	15.6	19.8	5.0	15.8

It will be seen that the new strain which is now being grown and used by the Dominion Sugar Company has produced a higher yield of roots per acre than the Kleinwanzlebener variety in each of the past four years.

To grow sugar beets to supply the three large sugar beet factories in Ontario will require about 450,000 pounds of seed per annum. In 1917 the Dominion Sugar Company grew one hundred acres of seed, which furnished about one-fifth of the requirements. It is proposed in 1918 to grow at least two hundred acres of beet seed, which should produce under favorable conditions, 150,000 pounds of seed or about one-third of the requirements for Ontario. It is expected by 1919 or 1920 to grow at least five hundred acres of beets for seed production. In former years practically all of the sugar beet seed was obtained from Europe. At the annual meeting of the Experimental Union, held at the Agricultural College in January, 1918, Mr. Henry Stokes, Agriculturist of the Dominion Sugar Company, stated that he was obtaining excellent results from sugar beet seed produced in Ontario. Great care had been taken in the selection of roots for seed production, with the result that there had been an increase in the amount of sugar from beets of one-half per cent.

#### WHOLE AND BROKEN SEED CLUSTERS.

Sugar beet seeds are about equal in size to the seeds of common red clover. They are embedded in a dry husk which surrounds from one seed to six or seven seeds. These husks with the enclosed seeds are usually called clusters. When the whole clusters are used for sowing there is an unevenness in the stand of plants. Naturally, the number of plants from the clusters vary from one to several. Where a number of plants are produced from one cluster, a considerable amount of labor is involved in thinning the roots. Various methods have been tried at our College with the object of breaking the clusters, so that the seed could be sown more regularly and thus permit of a uniform distribution of plants. Of the various methods of breaking or crushing the husks, no simple process has yet been found for liberating the seeds without injuring their power of germination. In an experiment conducted in duplicate in each of two years with seeds which had been broken, it was found that whole seed gave an average yield of 30.1 and broken seed of 11.8 tons of roots per acre per annum. It is possible that some process may yet be devised by which the sugar beet seeds may be separated from the husks without seriously injuring their vitality.

#### SOAKING SUGAR BEET SEED CLUSTERS.

In each of five years an experiment was conducted at the College in studying the influence on root production from soaking sugar beet seed clusters before sowing. The experiment was conducted in duplicate each year. For each test, seed was soaked 12, 24 and 36 hours, and these lots were tested with another lot of seed which had not been soaked. In the average of the ten tests conducted in the experimental grounds in the five years, the following average annual yields in roots per acre were obtained: Seed soaked 12 hours, 14.7 tons; seed soaked 24 hours, 15.2 tons; seed soaked 36 hours, 14.8 tons; and unsoaked seed, 13.3 tons. In each of the five years the unsoaked seed gave the lowest results and in each of three years the seed which was soaked for 24 hours gave the highest returns.

#### SELECTION OF SUGAR BEET SEED CLUSTERS.

A large amount of experimental work has been done at the Ontario Agricultural College recently in determining the influence of different selections of seed upon the resulting crop. The tests with cereals and with turnips, carrots and rape are quite definite. Those with mangels and sugar beets, however, are somewhat peculiar, owing to the fact that it was necessary to plant clusters instead of single seeds. In the case of sugar beet seed clusters, duplicate experiments were conducted in which the clusters of the different selections were planted separately, and duplicate experiments were also conducted by planting three large, five medium or eight small clusters in each place where it was desirable for a root to grow. This was done to insure a perfect stand of roots. The plants were afterwards thinned, leaving one plant in each place, and having the plants of the different selections of each class at equal distances apart. When the roots were harvested, the yields of the duplicate tests of each method were averaged. The following table gives the average results of the duplicate tests made by means of each of two methods of comparison in order to ascertain the amount of influence of the size of root clusters on the yield of roots produced:



Method of Planting.	Size of Clusters.	Yield of Roots per Acre. (Tons.)
Plots in which one plant was left from each seed cluster .....	Large Medium Small	23.25 21.32 13.43
Plots in which one plant was left from each of several seed clusters .....	Large Medium Small	22.54 22.37 15.05

Each of the two sets of results represents the average of ten separate tests conducted in the five-year period. In every instance the mangels produced from seeds in the large clusters were higher in average yield per acre than those from seeds in the smaller clusters. It has been the aim of some sugar beet seed growers to produce single seeded clusters. Whether this can be done and at the same time realize as large yields per acre from the single seeded clusters as from the larger clusters appears doubtful. These experiments seem to show that the largest yields of sugar beets per acre are obtained from seed clusters of good size.

#### FLAT AND RIDGED CULTIVATION.

An experiment was conducted for five years in succession by sowing sugar beets on the level and on ridges. The ridges were made with a double mould-board plough and to a height of about three inches. The soil on which the experiment was conducted was an average clay loam, and the elevation of the land varied somewhat in the different years. The Kleinwanzlebener variety of sugar beets was used, and the experiment was conducted in duplicate throughout. The rows were twenty-one inches apart and the plants were thinned to seven inches apart in the rows. The following table gives the average of the two tests in each of the five years of the experiment and for the average of the five-year period:

Cultivation.	Yield of Roots per Acre (Tons).					
	First Year.	Second Year.	Third Year.	Fourth Year.	Fifth Year.	Average Five Years.
Flat .....	20.6	21.0	14.8	18.2	20.5	19.0
Ridged .....	19.8	19.7	15.1	18.6	17.1	18.1

In three out of five years the flat cultivation gave the highest returns, the average for the whole period being almost one ton per acre in favor of working the land on the level. In the two years in which the yield per acre was slightly better from the ridged cultivation, there was more rainfall than usual in the early part of the season. On an average clay loam and in ordinary seasons the land which is cultivated on the level seems to give rather higher returns than that which is ridged before the seed is sown.

### SOWING SUGAR BEET SEED AT DIFFERENT DEPTHS.

In each of five years an experiment was conducted in sowing sugar beet seed at the depths of  $\frac{1}{2}$  inch, 1 inch,  $1\frac{1}{2}$  inches, 2 inches, 3 inches and 4 inches in order to glean information regarding the depth at which the best results would likely be obtained throughout a series of years. The experiment was conducted in duplicate each year and on an average clay loam of different elevations. Level cultivation was used throughout. The rows were twenty-one inches apart and the roots were thinned to seven inches apart in the rows. The following table gives the average results of the two tests in each of five years and for the average of the five-year period:

Depths.	Yield of Roots per Acre (Tons).					
	First Year.	Second Year.	Third Year.	Fourth Year.	Fifth Year.	Average Five Years.
$\frac{1}{2}$ Inch.....	27.0	15.1	20.9	18.3	18.1	19.9
1 ".....	25.3	11.6	14.1	15.1	19.8	17.2
$1\frac{1}{2}$ Inches.....	24.5	5.5	14.3	10.6	17.1	14.4
2 ".....	24.6	2.6	13.5	9.8	18.3	13.8
3 ".....	21.8	.3	9.6	7.6	13.8	10.6
4 ".....	14.3	1.6	1.2	4.5	7.6	5.8

The results show that in four out of the five years, the highest yields per acre were secured from the seed which was sown exactly  $\frac{1}{2}$  inch below the surface, and in the other year the highest yield was obtained from the seed which was sown 1 inch deep. In the average of the five years the results are decidedly in favor of the shallow sowing. It should be understood that the land in every instance was in a good state of cultivation. Had the land been lumpy or poorly worked it is quite possible that a slightly deeper sowing than  $\frac{1}{2}$  inch might have been necessary for the best returns.

### QUANTITY AND QUALITY OF SUGAR BEETS AS AFFECTED BY THE DISTANCES BETWEEN THE ROWS.

An experiment was conducted in duplicate in each of five years by sowing sugar beet seed clusters in rows which were made at different distances apart. Seven rows were sown in each plot. The outside rows were discarded and only the five inner rows were taken into consideration when determining the yields of the plots. The roots were thinned to a distance of seven inches apart in the rows. The Kleinwanzlebener variety was used. The test was conducted in the experimental grounds on an average clay loam, varying slightly in elevation from year to year.

Not only were the yields per acre determined, but the roots were also analyzed in the chemical laboratory at the College and the quantity and the quality of the sugar was thus ascertained. The following table gives the average of the five years' results of the percentage of sugar, the purity of juice, the average weight per root, and the yield of both tops and roots per acre for each of the different distances allowed between the rows:

Distance Apart (Inches).	Juice.		Roots.	
	Average Five Years (10 Tests).		Average Five Years (10 Tests).	
	Percentage Sugar.	Percentage Purity.	Weight per Root (Pounds).	Yield per Acre (Tons).
12 .....	17.0	86.7	.62	20.52
14 .....	16.9	87.4	.65	19.19
16 .....	16.7	86.1	.73	19.30
18 .....	16.8	87.7	.80	18.90
20 .....	16.8	87.1	.87	18.65
22 .....	16.3	86.0	.94	18.44
24 .....	16.7	87.3	.99	18.10
26 .....	16.6	87.7	1.04	17.68
28 .....	16.6	86.9	1.11	16.96

Claims were made in Europe that sugar beets grown comparatively close together possessed a higher percentage of sugar than those grown at a greater distance apart. In our experiments at Guelph, however, the composition of the roots grown in rows at different distances apart shows but slight variations either in the percentage of sugar or in the purity of the juice. It should be remembered, however, that in no cases were the plants far enough apart to produce very large roots. It is interesting to note that, with one slight exception, as the distance between the rows increased, the average yield per acre decreased. It is a general practice in Ontario, when growing roots for sugar production, to have the rows from 18 to 22 inches apart.

#### THINNING SUGAR BEETS AT DIFFERENT DISTANCES APART IN THE ROWS.

In each of five years in succession an experiment was conducted by thinning plants 2, 4, 6, 8 and 10 inches apart in the rows. This experiment was conducted in duplicate each year and the Kleinwanzlebener variety was used. The roots were grown on an average clay loam and the elevation varied somewhat with the different seasons. Flat cultivation was used throughout. The rows were twenty-one inches apart throughout, except in one year when they were only eighteen. The following table gives the average of ten tests conducted in five years:

Distance Between Plants.	Average Weight per Root (Pounds).	Average Yield per Acre (Tons).	
		Tops.	Roots.
2 Inches .....	.39	9.45	17.75
4 .....	.64	6.96	15.80
6 .....	.83	6.89	15.74
8 .....	1.03	6.82	15.67
10 .....	1.25	6.35	15.48

The results show that as the distance between the roots increased, there was an increase in the average size of the roots, but a decrease in the yields of both

tops and roots per acre. Taking everything into consideration, the roots which are thinned from eight to ten inches apart usually give good results.

#### THINNING ROOTS AT DIFFERENT STAGES OF GROWTH.

In thinning sugar beets at different stages of growth in a duplicate test in each of five years, it was found that those roots which were thinned when at a height of two inches, surpassed those which were not thinned until they had made a growth of eight inches, by an average of 1.3 tons per acre per annum. Sugar beets thinned when two inches high gave an increase in yield of one-half ton per acre over those thinned when only one-half inch high, and one-third ton per acre more than those which were not thinned until they had made a growth of five inches. In the average of the five years results, sugar beets which were thinned when two inches in height, produced the heaviest average weight of roots and the lowest yield of tops per acre in comparison with those thinned at any one of three other stages of growth.

#### CULTURAL METHODS.

The sugar beet does best on a warm, moist soil having an open subsoil which is also naturally warm and moist. Almost any soil, however, by proper cultivation in a suitable climate, will grow sugar beets. Good crops may be grown on clay, loam or sandy soils, providing they are not cold or wet, or that the subsoils are not hard and impervious to air and moisture. A soil capable of producing a good crop of potatoes or of corn will yield, with proper cultivation, satisfactory crops of sugar beets.

It is a good plan to grow sugar beets after such crops as potatoes, corn or winter wheat which had previously received a good application of farmyard manure. Sugar beets can be followed to good advantage by spring wheat, spring rye, barley or oats, any one of which could be seeded with clover alone or with a mixture of clover and timothy. It will, therefore, be seen that sugar beets fit in nicely in either a four or a five years' rotation. If it is necessary to apply farmyard manure immediately before the sugar beet crop, it is considered best to use well rotted manure in the autumn and have this worked into the soil. The use of commercial fertilizers can best be determined by local experiments to ascertain the requirements of the soil. In the use of fertilizers it will also be necessary to consider the prices of potash, phosphoric acid and nitrogen as some of these are abnormally high at the present time.

Sugar beets require a deep, mellow soil. It is advisable to plough the land to a good depth in the autumn. If well rotted manure is spread on the land in the autumn it is an excellent practice to make ridges about thirty inches apart with a double mould-board plough. This conserves the fertility in the ridges and enables the frost and the water to disintegrate the subsoil. Land treated in this way is in an excellent condition for cultivation in the spring. Before the sugar beet seed is sown the land should be thoroughly cultivated and rolled so as to make the soil compact and firm. By means of a light harrow, a fine seed bed could then be formed. About fifteen pounds of seed per acre is usually sown either with a beet drill or with an ordinary grain drill by using every third tube, which makes the rows about twenty-one inches apart. It is usual to sow sugar beets during the first half of May. If large areas are to be sown, however, it is well to sow the seed at two or three dates, allowing from ten days to two weeks between each two sowings. This distributes the labor of thinning and



harvesting over longer periods. Cultivation should start as soon as the beets appear above ground and should be continued at frequent intervals in accordance with the weather and soil conditions throughout the growing season.

#### BY-PRODUCTS OF THE BEET SUGAR INDUSTRY.

In connection with the growing of sugar beets and the production of beet sugar there are several by-products which will undoubtedly be used to greater advantage in the future than they have been in the past. Three of the important by-products are here referred to.

**SUGAR BEET TOPS.** The yield per acre per annum of the sugar beet tops grown at the College by the Kleinwanzlebener variety in the average of twenty-one years has been 6.5 tons, or practically two-fifths of the yield of roots. According to Henry's book on "Feeds and Feeding" the following gives the fertilizing constituents per ton of sugar beet roots and of sugar beet tops:

Sugar Beets.	Fertilizing Constituents per Ton.		
	Nitrogen (Pounds).	Phosphoric Acid (Pounds).	Potash (Pounds).
Roots .....	5.2	1.6	6.4
Tops .....	8.4	2.0	12.8

It will be seen that the tops are much richer in fertilizing constituents than the roots of sugar beets when equal quantities are compared. It is exceedingly important to carefully retain on the land the fertility contained in the tops. As a rule the tops are ploughed in the soil. They are occasionally, however, fed green or in the form of silage. Caution should be used in feeding sugar beet tops as they tend to purge the animals, and, therefore, should be fed in limited quantities in conjunction with dry roughage.

**SUGAR BEET PULP.** Formerly, sugar beet pulp was fed when fresh in a limited way to farm stock in near proximity to the factories. More recently, however, the pulp has been dried, shipped and sold as stock feed.

**LIME.** A large amount of lime is used in the process of manufacturing beet sugar. At present this by-product is wasted. It seems a great pity that this lime could not be used for agricultural purposes. There is room for greater economy along this line.

#### CONCLUSION.

As sugar beets are grown with the definite object of sugar production, the growers of the beets and the manufacturers of the sugar should work in wholesome co-operation. The sugar manufacturers furnish seed of high quality at low prices, give directions regarding cultivation and offer to buy the beets under contract. Ontario farmers desiring to grow sugar beets should therefore make their contracts before planting.